

## Method Development and Measurements of Polybrominated Diphenyl Ethers (PBDEs) in Tissue, Serum, and Sediment SRMs

*Polybrominated diphenyl ethers (PBDEs) are flame retardant compounds that are commonly added to many plastics, resins, and textiles that are then incorporated into products such as TVs, computers, furniture, and carpets. PBDEs can volatilize or leach out of the products in which they are applied and be transported long distances in the environment, due to their physico-chemical properties. Methods have been developed to quantify PBDEs in a variety of environmental-matrix Standard Reference Materials (SRMs), and the predominant PBDE congeners have been quantified in marine tissue, human serum, and sediment. The Centers for Disease Control and Prevention (CDC) also provided data for PBDE congeners in the human serum SRM. Data from these methods have been combined to value assign a variety of NIST SRMs for PBDE concentrations.*

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Polybrominated diphenyl ethers (PBDEs) are flame-retardant compounds that are commonly added to many plastics, resins, and textiles, and then incorporated into consumer products. PBDEs can leach out of these products and are now considered ubiquitous environmental contaminants. Much attention has been focused on their transport, uptake, and fate in both the environment and in humans. Presently, there is an increased need for measurements of PBDEs in environmental matrices and human serum. Reference materials certified for PBDEs are needed to ensure the quality of these measurements.

Ten SRMs have been characterized for a suite of 26 PBDE congeners using gas chromatography with mass spectrometric detection operated in both the electron impact and the negative chemical ionization modes. These SRMs include matrices such as marine mammal tissue, fish tissue, mussel tissue, human serum, marine sediment, and house dust (see Figure). The development of gas chromatographic methods using cool on-column injection and appropriate capillary columns has allowed for the measurement of the fully brominated PBDE (2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether; PBDE 209) using an isotopically labeled PBDE 209 as an internal standard for quantification of PBDE 209 in these materials. This congener has often been difficult to measure due to its thermal instability and its degradation at elevated temperatures. PBDE 209 was observed to be the dominant PBDE congener in the sediment and house dust SRMs, and thus,

these SRMs will be very useful for laboratories interested in routine measurements for PBDE 209.

### Impact:

The concentrations and relative contributions of the PBDE congeners measured in these SRMs are indicative of levels measured in environmental samples, illustrating their use as quality control materials. Additional values are reported for two sediment SRM materials used recently in an inter-laboratory comparison exercise and the results support the use of these materials as reference materials for sediment studies.

Legislation has been passed to reduce the use of PBDEs in consumer products, but these compounds have already become ubiquitous in our environment.

### Future Plans:

Other flame retardants such as hexa-bromocyclododecane (HBCD) are now being used at higher rates as a replacement for PBDEs in some parts of the world. Therefore, there is interest in the determination of the concentrations of HBCD in environmental samples. Evidence also suggests that PBDEs may be metabolized by some organisms to hydroxylated and methoxylated derivatives. Selected methoxylated PBDEs (MeOBDEs) have been quantified in marine mammal blubber and cod liver oil SRMs.

**PBDE congener composition in human serum (in pg/g) and environmental biota (in ng/g wet mass) SRMs based on certified and reference concentrations.**

